Energy drinks, caffeine, junk food, breakfast, depression and academic attainment of secondary school students

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Abstract

Background: Energy drinks are widely consumed, and concerns have been raised about possible negative outcomes.

Aims: The aim of the present research was to examine associations between consumption of energy drinks, caffeine, and junk food, and academic attainment in a sample of UK secondary school students.

Methods: 3071 students agreed to participate in the study; 2677 completed the survey on one occasion (52.4% female, 47.6% male; approximately 20% of the sample from each school year) and 1660 (49.6% female, 50.4% male) completed the survey a second time, approximately 6 months later. The academic attainment measure was based on Key Stage 3 (KS3) and Key Stage 4 (KS4) grades for Maths and English.

Results: In the cross-sectional analyses, logistic regressions showed that consumption of energy drinks was associated with a greater likelihood of being in the low academic achievement group. This was not found for other sources of caffeine. The effect of energy drinks was still significant when demographic, academic, and health/lifestyle variables were covaried. However, inclusion of an unhealthy diet variable (junk food) removed the significant effect of energy drinks. Similar observations were made in the longitudinal study, with the poorer attainment of those who consumed energy drinks reflecting breakfast omission and depression.

Discussion: The present findings indicate that consumption of energy drinks is associated with an increased likelihood of poor academic attainment that reflects energy drink consumption being part of an unhealthy diet or being associated with skipping breakfast rather than a more specific effect, such as being a source of caffeine. Although the current study extends on previous research by utilising a longitudinal design, intervention studies are now required to better answer questions relating to causality and direction of effect.

Key words: *Energy drinks; Junk food; Caffeine; Depression; Academic attainment*

Introduction

Energy drinks are caffeinated soft-drinks containing other ingredients such as taurine and glucose. They are marketed to increase physical and mental energy, and should not be confused with sports drinks intended to provide rehydration and replenish electrolytes lost during exercise. Energy drinks first appeared in the 1960s, and now form a multi-billion-dollar industry with widespread availability and consumption. The safety and efficacy of these drinks has been debated, with some articles claiming negative effects (Kaminer, 2010; Miller, 2008; Reissig, Strain and Griffiths, 2009; Seifert et al., 2011) whereas others report equivocal results (Ishak et al., 2012; Striley and Khan, 2014). A range of outcomes have been examined, and some research has focused on serious health problems such as tachycardia, arrhythmia, stroke, seizures, and psychotic symptoms (Seifert et al., 2011). Other research has examined mental health (e.g. Richards and Smith, 2016a) and negative behaviour (e.g. behavioural sanctions at school; Richards, 2016; Richards et al., 2015).

The focus of the present research was on the academic attainment of secondary school students. Acute effects of consuming energy drinks have usually been positive (Scholey and Kennedy, 2004; Wesnes, Barrett and Udaani, 2013) but not always (Bloomer et al., 2015; Buckenmeyer et al., 2015). Effects of energy drinks on cognitive function have been interpreted in terms of caffeine (Wesnes, Barrett and Udaani, 2013) or glucose (Wesnes et al., 2017) whereas changes in physical performance have been attributed to taurine (Souza et al., 2017). The behavioural effects of caffeine in adults are largely beneficial (Doepker et al., 2016; Poole et al., 2017; Smith, 2002) but it has also been suggested that negative effects may occur with high doses (> 400mg) and in sensitive individuals (European Food Safety Authority, 2015; Smith, 2002). Energy drinks often contain high doses of caffeine (compared to other soft drinks such as colas), and children may be considered a sensitive group due to their smaller body size, relative caffeine naivety, and developing CNS. It is also plausible that negative effects may reflect impaired sleep (Owens, Mindell and Baylour, 2014) or increased anxiety (Childs, 2014). Previous research has suggested that both caffeine (Beamish et al., 2016; James, Kristjánsson and Sigfúsdóttir, 2011) and energy drink consumption (Azagba, Langille and Asbridge, 2014; Champlin, Pasch and Perry, 2016; Martz, Patrick and Schulenberg, 2015; Pettit and DeBarr, 2011; Trunzo et al., 2014) are associated

with lower academic attainment scores. The present study was designed to extend this research, and to give further consideration to underlying mechanisms.

Many of the previous studies of energy drinks and academic attainment have not controlled for known covariates. This issue was addressed in the present study. Earlier results from cross-sectional studies could also reflect reverse causality (or simply correlation). The present study involved longitudinal comparisons, which provide a better indication of causality. Our earlier research has shown that a combination of consuming energy drinks and missing breakfast was associated with the acute occurrence of behavioural sanctions (Richards et al., 2015). Other research has shown that consumption of energy drinks is associated with an unhealthy diet (Littlecott et al., 2016; Poulos and Pasch, 2016), and in the present study dietary variables were covaried. These dietary variables focused on healthy foods (fruit and vegetables), consumption/skipping of breakfast, and junk food. Junk food can be defined in a number of ways (see Smith, 2000), such as being high in calories but low in nutritional content, or being ready prepared, highly processed, and not well-balanced. Junk food is often high in fat and/or high in sugar. Examples of junk food are potato chips (fries), sweets (candy), fried fast food, pies, and processed meat. Furthermore, as effects relating to energy drinks have often been interpreted as reflecting the ingestion of caffeine, the current study recorded other sources of caffeine to test this view.

The aims and objectives of the present study were to use a multivariate approach to examine cross-sectional and longitudinal associations between energy drinks, caffeine, junk food, and the academic attainment of secondary school students whilst adjusting for possible confounding factors. This approach also allowed identification of possible underlying mechanisms.

Method

The study was carried out with the approval of the ethics committee (ethical clearance number: EC.12.09.11.3187), School of Psychology, Cardiff University, and the informed consent of the volunteers and their parents.

Participants

A sample size calculation suggested that a cross-sectional sample of 1500 would be sufficient to detect small effects of the potential risk factors after adjustment for multiple covariates (Hsieh, 1989). 3071 pupils from 3 Cornish academies (state funded secondary schools in England, which are directly funded by the Department for Education, and that are independent of local authority control) consented to participate. Volunteers were asked to complete two surveys carried out approximately 6 months apart. Some volunteers only completed one session (the cross-sectional sample – 87% response rate) and others completed both (the longitudinal sample – 62% of the cross-sectional sample). Details of the cross-sectional and longitudinal samples are provided in Table 1.

Insert Table 1 about here

The survey

The Diet and Behaviour Scale [DABS] (Richards, Malthouse and Smith, 2015) was administered on both occasions. This questionnaire is based on food frequency scales used to investigate specific foods (e.g. breakfast – Smith, 1998, 1999, 2003) or ingredients (e.g. caffeine – Brice and Smith, 2002; Hewlett and Smith, 2006). In addition, number of caffeinated beverages was recorded, which allows calculation of approximate amount of caffeine consumed. At time 2, three additional questions measuring stress, anxiety and depression were included (Richards and Smith, 2016a, b). Single-items were chosen because they can identify overall risk while reducing time costs; the single-items used here are based on similar items demonstrated to correlate well with full-length measures (see Williams, 2014, 2015; Williams and Smith, 2012, 2013). DABS measured food and drink frequency and also the number and amount of caffeinated beverages (coffee, tea, cola, energy drinks) consumed per week. The brand of energy drink most frequently consumed was also recorded. This information allowed calculation of the approximate amounts of caffeine consumed from different products (Richards and Smith, 2016b). The other important measures for this study were frequency of consuming junk food (potato chips [fries], fast food, crisps, gum, sweets, takeaways, pies/pasties, processed meat, fried fish, chocolate), and indicators of a healthy diet (fruit and vegetable consumption and breakfast). The questionnaire also recorded information on lifestyle (sleep, exercise) and general health status.

Student Information

The following information was made available from the School Information Management System (SIMS) and was merged with the questionnaire data to form an anonymous database. Variables from SIMS were: demographics (sex, school, school year, FSM); academic (attendance, behavioural sanctions, English grade, Maths grade, SEN).

Statistical analysis plan

Cross-sectional data: A series of three logistic regression analyses were carried out. The first examined the univariate cross-sectional association between energy drink consumption and attainment; the second controlled for demographic, health/lifestyle, and academic variables, as well as intake of caffeine from other sources (coffee, tea, cola); the third controlled for healthy and unhealthy diet (i.e. junk food) in addition to all the previously entered covariates.

Longitudinal data: A series of five logistic regression analyses were conducted. The first examined the univariate association between energy drink consumption at time 2 and attainment at time 2; the second controlled for energy drink consumption at time 1 and attainment at time 1; the third further controlled for demographic, health/lifestyle, and academic variables, as well as caffeine from other sources; the fourth added the healthy and unhealthy dietary variables; the fifth replaced the healthy and unhealthy diet variables with frequency of breakfast consumption/omission, and additionally included self-reported depression.

Dependent variable: The academic attainment measure was based on Key Stage 3 (KS3) and Key Stage 4 (KS4) grades for Maths and English. The grading systems differed in the three academies. For KS3, all academies used grades ranging from 8a (highest) to 1c (lowest) with three sub-categories within each major grade (e.g. 8a, 8b, 8c). This gave 24 potential grades. At KS4, each academy used a different system for grading work. The first academy used a system ranging from A+ to G-, with 3 separate sub-grades for each major category (e.g. A+, A, A-). A 'U' was also used indicating an ungraded standard of work (i.e. a fail), which meant that there were 22 possible grades. Academy 2 used a system ranging from A* to G (and U)

but no further sub-division within categories (i.e. 9 categories in total). Academy 3 used a system ranging from A*a (highest) to Gc (lowest) plus U for ungraded work. Each major category had 3 sub-levels (e.g. Aa, Ab, Ac), giving a total of 25 possible grades.

The data were recoded so that analyses could be conducted on the complete dataset. For each academy, grades were ranked from highest to lowest and then recoded using a median split to provide a high attainment group and a low attainment group for each academy for both Maths and English. An overall attainment score was calculated by summing Maths and English and then splitting the whole sample into those who were below the median for both Maths and English (the low attainment group: 36% T1; 40% T2) and those who were above the median for at least one subject (the high attainment group: 64% T1; 60% T2).

Covariates:

The following were categorical covariates: sex, school, school year, SEN status, FSM status. School attendance, sleep, exercise, general health, healthy diet, and junk food were dichotomised based on median split; the behavioural sanctions variable was also dichotomous (this was based on number of detentions/behavioural points: ≥ 1 detention for academies 1 and 2 or highest 20% behavioural points for academy 3), as were frequency of breakfast consumption (every day/most days vs. never/once a month/once or twice a week), and depression (not at all/rarely vs. sometimes/frequently/very frequently). The covariate for caffeine from other sources was created by summing caffeine intake from coffee, tea, and cola, and dichotomising via median split. Subsequent analyses entered the lifestyle variables (exercise and sleep), general health, attendance, and caffeine from energy drinks and other sources as continuous variables.

Independent variables:

Amount of caffeine from energy drinks was calculated based on the number of drinks consumed per week and the preferred beverage (Richards and Smith, 2016b). This was initially entered into the regressions as a dichotomous variable (consumers vs. non-consumers). A second set of analyses entered energy drink consumption as a continuous variable.

Results

Cross-sectional data:

Table 2 shows the weekly amount of caffeine from the different beverages.

Insert Table 2 about here

A series of logistic regressions examining associations between caffeine from energy drinks and attainment were carried out and are summarised in Table 3.

Insert Table 3 about here

The first regression (Table 3, Model 1) showed that energy drink consumers were 1.39 times more likely to be in the low attainment group than non-consumers[1]. The next regression (Table 3, Model 2) included other sources of caffeine along with demographic, health/lifestyle, and academic covariates. This analysis showed that consumption of caffeine from other sources was not a significant predictor, and that the energy drink effect was still present[2].

Energy drink consumption was associated with more frequent consumption of junk food and less frequent consumption of fruit, vegetables and breakfast (see Table 4).

Insert Table 4 about here

The final regression (Table 3, Model 3) also included junk food and healthy diet variables. Members of the high junk food group were 1.30 times more likely to be in the low attainment category than were members of the low junk food group. The effect of consuming energy drinks was no longer significant in this analysis[3]. Further regressions (not shown) revealed that the effects of junk food were not associated with any specific product but reflected the combined effect of consuming these types of food.

[1] This effect was also significant when caffeine from energy drinks was entered as a continuous variable ($p = 0.009$).

[2] Similar effects were observed when energy drinks and caffeine from other sources were entered as continuous variables (energy drinks: $p = 0.004$; other sources of caffeine: $p = 0.113$).

[3]Identical effects were obtained when these factors were entered as continuous variables (junk food: $p = 0.019$; energy drinks: $p = 0.664$).

Longitudinal data:

Those who completed the survey at both times did not differ in the dietary scores from those who only completed it once. The longitudinal sample had fewer students from the SEN and FSM categories, and also fewer students in the high attainment category. While these differences were statistically significant, the magnitude of the effects were small. The multi-variate analyses also adjusted for the influence of these factors. A series of logistic regressions were carried out, and the results of these are shown in Table 5. Energy drink consumption at time 2 was again associated with an increased risk of being in the low attainment category at time 2 (Table 5, Model 1)[4].

Insert Table 5 about here

In the next regression (Table 5, Model 2), the time 1 energy drink and attainment variables were included as covariates. The effect of consuming energy drinks at time 2 remained significant[5]. The next analysis (Table 5, Model 3) also included caffeine from other drinks as well as demographic, health/lifestyle, and academic covariates. Again, the effects of consuming energy drinks remained significant[6]. The next analysis (Table 5, Model 4) included junk food and healthy diet. Having a healthy diet was associated with better academic attainment, and in this analysis the effect of consuming energy drinks was just short of statistical significance ($p = 0.056$)[7]. Junk food had no significant effect in this analysis. In the final regression model, the healthy food and junk food variables were

[4] This was also found when it was entered as a continuous variable ($p < 0.001$).

[5] An identical effect was found when it was entered as a continuous variable ($p < 0.001$).

[6] A similar effect was found when it was entered as a continuous variable ($p = 0.016$).

[7] The energy drink effect was just significant when it was entered as a continuous variable ($p = 0.042$).

replaced by frequency of breakfast consumption/omission, and self-reported depression was also entered as a covariate (Table 5, Model 5). The effect of healthy diet appeared to largely reflect consumption of breakfast (skipping breakfast was associated with depression, Spearman's rho = 0.17, $p < 0.001$, though was not associated with consumption of junk food (Spearman's rho = 0.01 $p > 0.05$), and there was no significant effect of consuming energy drinks ($p = 0.093$)[8].

Discussion

The aim of the present study was to examine the association between consumption of energy drinks and the academic attainment of secondary school students. Previous research has suggested that energy drink consumption may be associated with poor attainment. However, previous studies have often had methodological weaknesses that limit their impact. These weaknesses range from use of cross-sectional designs, which make it difficult to assign causality, to lack of control of key covariates (factors related to attainment, energy drink consumption, or both). The current research used a longitudinal design, and recorded information on relevant covariates. The sample size was also large enough to detect effect sizes indicated in the literature, and to allow for inclusion of appropriate variables in the analyses.

Our research also aimed to identify underlying mechanisms linking energy drink consumption to attainment. Energy drinks contain high levels of caffeine, and previous research has suggested that it is the caffeine content that underlies behavioural effects. If this is the case, impairments should also be associated with caffeine from other sources. Energy drink consumption has been associated with a diet high in junk food and lacking healthy components (e.g. fruit and vegetables; regular consumption of breakfast). This possibly suggests a greater emphasis on high fat/high sugar diets rather than specific ingredients (such as caffeine). Our earlier research on energy drinks and behavioural sanctions (Richards et al., 2015) demonstrated that it was a combination of missing

[8] Similar findings were obtained when the scores were entered as continuous variables (breakfast, $p < 0.001$; energy drinks, $p = 0.146$).

breakfast and consuming energy drinks that was associated with an increased risk of problem behaviour.

Univariate analyses of the data from the present study showed that those who consumed energy drinks were more likely to be in the low attainment category than were non-consumers. This was found in both cross-sectional and longitudinal analyses, and the effects remained significant when consumption of caffeine from other sources, and demographic, health/lifestyle, and academic factors were covaried. An association between attainment and other sources of caffeine was not observed, which suggests that the effect of energy drinks reflected some other mechanism. The results confirmed that those who consumed energy drinks were also more likely to eat junk food and less likely to have a healthy diet. In the cross-sectional analysis, the energy drink variable was no longer significant when junk food was included in the regression. While these results show associations between dietary variables and attainment, one should be careful not to consider these cross-sectional results as demonstrating causal relationships. Smith (2003, 2014) has argued that it may be the behavioural outcome that influences diet rather than causality occurring in the other direction.

In the longitudinal analysis, the effect of consuming energy drinks was no longer significant when healthy diet was included in the regression (although it should be noted that the effect only narrowly missed being considered statistically significant, $p = 0.056$, and indeed was statistically significant when energy drink consumption was entered as a continuous variable, $p = 0.042$). The effect further attenuated ($p = 0.093$) when the junk food and healthy diet variables were replaced with frequency of breakfast consumption/omission, and self-reported depression was also included as a covariate. Overall, these findings suggest that energy drinks are associated with poor academic attainment because they are part of an unhealthy diet. Research has shown that diet influences attainment, and there are plausible CNS mechanisms that underlie such effects (Yeomans, 2017). Yeomans reviewed animal and human research, and concluded that repeated consumption of high fat or high fat/high sugar diets leads to specific impairments in the functioning of the hippocampus, which causes reduced cognitive performance.

The present study addressed many of the problems encountered by previous research (e.g. it utilised a longitudinal design, and controlled for a range of potentially confounding covariates). However, there were still limitations, and further research is required to extend these findings. A major weakness was having to dichotomise academic attainment rather than being able to analyse it as a continuous variable. Furthermore, the current study did not examine or control for caffeine consumed from products other than drinks (e.g. chocolate, caffeine tablets, certain types of medication). Another limitation was that parental and peer influences on attainment and diet were not recorded. Indeed, these may be key ways to change diet and improve attainment, and future research should examine the efficacy of different interventions rather than just studying naturally-occurring variation.

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Table 1: Characteristics of the cross-sectional and longitudinal samples

	Cross-sectional sample	Longitudinal sample
N	2677	1660
% Male	47.6	50.4
% SEN	21.8	18.6
% FSM	11.7	11.2
Year 7 (% of total sample)	18.2	19.7
Year 8 (% of total sample)	22.7	19.7
Year 9 (% of total sample)	20.1	21.9
Year 10 (% of total sample)	19.3	18.1
Year 11 (% of total sample)	19.8	19.8

Table 2: Caffeine (mg) per week from different beverages

	Mean	95% CI	% non-consumers
Energy drinks	132.0	123.5-140.5	43.7%
Cola	37.3	35.5-39.0	24.8%
Coffee	112.5	102.9-122.2	53.1%
Tea	139.3	131.6-147.0	31.6%

Table 3: Cross-sectional logistic regressions examining associations between energy drink consumption and attainment.

	Model 1 (univariate)			Model 2 (demographics + caffeine)			Model 3 (healthy diet + junk food)		
Predictor variables	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***
Energy drinks	1.394	1.192, 1.630	**< 0.001**	1.306	1.085, 1.572	**0.005**	1.160	0.951, 1.415	0.144
Other caffeine				0.864	0.721, 1.036	0.114	0.840	0.695, 1.015	0.072
Low attendance				1.614	1.348, 1.932	**< 0.001**	1.671	1.384, 2.016	**< 0.001**
High detention score				2.721	2.138, 3.464	**< 0.001**	2.749	2.136, 3.538	**< 0.001**
Poor health				1.035	0.845, 1.269	0.737	0.994	0.801, 1.233	0.956
Female sex				0.864	0.721, 1.037	0.116	0.863	0.714, 1.044	0.130
School				0.941	0.830, 1.068	0.349	0.954	0.835, 1.089	0.484
Older school year				0.703	0.663, 0.745	**< 0.001**	0.710	0.669, 0.754	**< 0.001**
Not SEN				0.169	0.135, 0.210	**< 0.001**	0.185	0.147, 0.232	**< 0.001**
Not FSM				0.645	0.490, 0.848	**0.002**	0.612	0.460, 0.814	**0.001**
Frequent mild exercise				0.742	0.612, 0.899	**0.002**	0.804	0.656, 0.985	**0.035**
Longer sleep				0.943	0.774, 1.149	0.558	0.910	0.740, 1.119	0.370
High junk food							1.299	1.072, 1.575	**0.008**
High healthy diet							0.862	0.712, 1.045	0.130
Cox & Snell R^2		0.006			0.225			0.217	

Note. High odds ratios = more likely to be in low attainment category; statistically significant p values (p < 0.05) are presented in bold.

Table 4: Energy drink consumption, junk food frequency and healthy diet frequency (mean ratings, higher scores = more frequently consumed; s.e.s in parentheses; ratings on a 5-point scale from Never to Very Frequently).

	Non-consumers	Energy drink consumers
Chocolate	3.34 (0.023)	3.49 (0.027)
Crisps	3.48 (0.027)	3.60 (0.031)
Gum	2.52 (0.028)	3.15 (0.034)
Sweets	2.86 (0.022)	3.17 (0.025)
Fast food	2.14 (0.016)	2.44 (0.022)
Takeaways	1.80 (0.016)	2.05 (0.020)
Pies/pasties	2.16 (0.019)	2.40 (0.026)
Processed meat	1.95 (0.033)	2.14 (0.039)
Fried fish	1.97 (0.021)	2.13 (0.026)
Chips	2.78 (0.019)	3.12 (0.025)
Fruit & vegetables	2.82 (0.048)	2.56 (0.055)
Breakfast	4.21 (0.029)	3.72 (0.040)

Note. All differences significant, $p < 0.001$.

Table 5. Longitudinal logistic regressions: associations between energy drink consumption and attainment at T2.

	Model 1 (univariate)			Model 2 (T1 attainment + energy drinks)			Model 3 (demographics + caffeine)			Model 4 (junk food + healthy diet)			Model 5 (breakfast + depression)		
Predictor variable	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***	***OR***	***95% CI***	***p***
Energy drinks	1.945	1.593, 2.374	**< 0.001**	1.470	1.147, 1.885	**0.002**	1.363	1.045, 1.780	**0.023**	1.302	0.993, 1.707	0.056	1.259	0.963, 1.648	0.093
Attainment (T1)				12.436	9.758 15.849	**<0.001**	8.997	6.923, 11.693	**< 0.001**	9.047	6.950, 11.776	**< 0.001**	9.285	7.114, 12.119	**< 0.001**
Energy drinks (T1)				1.010	0.787, 1.296	0.937	0.967	0.745, 1.257	0.804	0.963	0.740, 1.252	0.776	0.937	0.720, 1.220	0.628
Other caffeine							1.020	0.792, 1.315	0.877	0.993	0.768, 1.284	0.958	0.960	0.742, 1.241	0.754
Low attendance							1.419	1.108, 1.818	**0.006**	1.394	1.086, 1.788	**0.009**	1.334	1.038, 1.715	**0.024**
High detention score							1.287	0.885, 1.872	0.187	1.266	0.869, 1.845	0.220	1.225	0.840, 1.788	0.291
Poor health							0.991	0.758, 1.295	0.945	0.969	0.740, 1.268	0.818	0.950	0.725, 1.246	0.711
Female sex							1.047	0.812, 1.349	0.725	1.026	0.796, 1.324	0.841	0.900	0.692, 1.170	0.432
School							1.190	0.992, 1.426	0.060	1.207	1.006, 1.447	**0.043**	1.228	1.023, 1.473	**0.028**
Older school year							0.952	0.869, 1.043	0.293	0.941	0.858, 1.032	0.195	0.936	0.853, 1.026	0.158
Not SEN							0.336	0.251, 0.452	**< 0.001**	0.342	0.254, 0.459	**< 0.001**	0.353	0.263, 0.475	**< 0.001**
Not FSM							0.747	0.504, 1.108	0.147	0.747	0.503, 1.110	0.148	0.766	0.515, 1.138	0.187
Frequent mild exercise							0.908	0.696, 1.185	0.477	0.912	0.699, 1.191	0.499	0.916	0.700, 1.197	0.520
Longer sleep							0.993	0.771, 1.278	0.956	1.012	0.785, 1.303	0.929	1.044	0.808, 1.348	0.741
High junk food										1.096	0.851, 1.413	0.477			
High healthy diet										0.708	0.551, 0.910	**0.007**			
High depression													1.522	1.175, 1.973	**0.001**
Frequent breakfast													0.620	0.478, 0.804	**< 0.001**
Cox & Snell R^2		0.020			0.277			0.323			0.309			0.314	

Note. High odds ratios = more likely to be in low attainment category; statistically significant p values (p < 0.05) are presented in bold.
All variables from T2 unless shown as T1.